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By WILLIAM C. THRO.

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DISTINCTIVE CHARACTERISTICS OF THE SPECIES OF THE GENUS LECANIUM.

The coccidæ or scale-insects have long been recognized as of great economic importance ; but in recent years, because of the ravages of the San José scale, the interest in this family has been much increased.

Since the family contains species that are comparatively harmless, as well as some of our most dreaded pests, the correct identification of the species becomes of vast practical as well as scientific value.

Much has been done towards working out the specific and generic distinctions of the members of this group ; this is especially true of the sub-family Diaspinæ. But the genus *Lecanium* has proved to be an extremely difficult one for the systematists ; they have described more than one hundred and fifty species, but no one has pointed out an available set of characters that can be used for distinguishing the species.

In the summer of 1899, at the suggestion of Professor Comstock, I began a study of the morphology of some species of the genus for the purpose of finding distinctive specific characters ; and this paper is the result of that study. The object has not been to monograph the genus nor to describe new species ; but merely to gain a knowledge of those external features that are available for distinguishing the species.

I wish to acknowledge my indebtedness to Prof. J. H. Comstock and the instructing staff of the Department of Entomology of Cornell University for aid and suggestions in the preparation of this bulletin, and for the use of museum material ; and to Prof. M. V. Slingerland, Prof. T. D. A. Cockerell, Prof. S. J. Hunter, Mr. Th. Pergande, Mr. G. B. King and Mr. E. M. Ehrhorn, for specimens furnished.

THE EXTERNAL FEATURES OF A LECANIUM.

Lecanium hesperidum Linn.

The following description of the characteristics of *Lecanium hesperidum* will serve as a basis for indicating the structural features that are available for distinguishing the species of this genus; and will define the terms used in the specific descriptions.

The outline of the body is oval with the broader part behind (Plate I, Fig. 1). The dorsum, composed of thick cuticle, is slightly convex; the ventrum, composed of thinner cuticle, is nearly flat. Each lateral margin has two depressions at the places where the grooves leading from the spiracles meet the margin, the *spiracular depressions*, (Plate I, Fig. 1, *sd*). The two eyes are on the dorsum near the margin of the forward end of the body but can be seen through the body from the ventral side (Plate I, Fig. 1, *e*). The antennæ, feet, spiracles, and mouth-parts are attached to the under side of the body in such a manner as to be invisible from above (Plate I, Fig. 1).

The anal plates.—The anal plates as seen from above are two triangular structures, joined throughout the cephalic third of their length, and located at the base of a crease extending from the hind end of the body (Plate I, Fig. 2). The cephalic portion of the plates is set in the dorsal wall of the body of which it forms a part. The caudal portion of each plate is a projecting lobe, which is triangular in cross-section, and contains an extension of the body-cavity (Plate I, Fig. 8).

In cross-section near the base of the free portion of each plate, the cuticle of the dorsal wall is thick and heavily chitinized, the lateral walls are thin, except the ventral edge where the cuticle is thick and heavily chitinized (Plate I, Fig. 7). Farther caudad the walls of the lobe are thick throughout (Plate I, Fig. 8). In cross-section at the place where the plates are joined the cuticle is dovetailed together (Plate I, Fig. 6).

The thickened ventral edge of the free portion of the lobe is extended cephalad forming the lateral boundary of an invagination of the body-wall between the opening of the vagina and anal tube (Plate I, Figs. 4 and 6, *si*; Plate II, Fig. 1).

The anal tube.—The anal tube is a chitinized invagination of the body-wall extending from beneath the anal plates forward to the anus, which is situated some distance from the exterior of the body (Plate I, Figs. 4, 5, 6 and 7; Plate II, Fig. 1). The invagination of the dorsal portion of the tube begins directly beneath the anal plates at the point where they divide and somewhat forward of the beginning of the ventral invagination (Plate I, Fig. 7; Plate II, Fig. 1).

The anus opens into the tube at its upper portion, which does not extend into the body cavity as far as the lower portion (Plate II, Fig. 1). The posterior portion of the rectum is much smaller than that immediately preceding it.

There are two large muscles attached to two projections of the cephalic end of the tube. On each side of the ventral portion of the tube and extending from the forward end a short distance caudad, there are densely chitinized strengthening processes (Plate I, Fig. 5; Plate II, Fig. 1). On the interior of the tube and attached to it in the form of a ring around the anus, there are six large and two small setæ that extend out beneath the anal plates (Plate I, Fig. 5, *sar*; Plate II, Fig. 1).

The opening of the vagina is in the ventral body-wall in front of the invagination below the opening of the anal tube (Plate II, Fig. 1).

Changes in the position of the plates. — In unborn young of *hesperidum* the anal plates are projections of the posterior portion of the body and probably correspond to the last abdominal segment (Plate II, Fig. 2). Shortly after birth the plates appear to have advanced forward, due probably to a backward growth of the lateral portions of the segments immediately preceding the last (Plate II, Fig. 3). In adults, the plates are some distance from the caudal margin (Plate I, Fig. 1) and the lobes of the body caudad of the plates have grown together (Plate I, Figs. 9 and 10). By these remarkable changes in the posterior segments of the body a protective covering is formed for the young. In the case of *hesperidum* a small portion of the ventral surface is concave and the young scales remain several days beneath the mother scale. With *hemisphaericum* the whole ventral surface of the body becomes concave and a large space is formed for the reception of the eggs. If the anal plates remained where they are in the young scales, the eggs and young would not be retained beneath the mother scale.

The setæ of the anal region.—The setæ on or near the anal plates may be designated as follows:

The eight, long, slender setæ arranged about the anus and extending out beneath the plates are termed *the setæ of the anal ring*.

The four setæ arranged along the margin at the beginning of the invagination of the ventral portion of the anal tube are termed *the fringe setæ*.

On the ventral part of the free portion of each plate there are two quite long setæ, *the subapical setæ*.

At the apex of each plate there are four small setæ termed *apical setæ* (Plate III, Fig. 4).

The antennæ.—The antennæ are long and slender and have seven segments. The fourth segment is the longest, the third and seventh subequal, the first and second subequal, and the fifth and sixth subequal. The first segment has one long and two short setæ, the second has two fairly long setæ, and what is probably a sense organ; the third has no setæ, the fourth has one long and two short setæ, the fifth has one, the sixth has two, and the seventh has at least seven setæ.

The legs.—The leg has a well developed coxa, trochanter, femur, tibia, and tarsus. The tarsus bears a claw, and two short and two long tenent hairs,* formerly called "digitules."

Spiracular setæ.—This term has been applied to the three setæ located in the depression of the margin, called the spiracular depression. There are two of these depressions on each side of the body at the points where the spiracular grooves, which extend from the spiracles, meet the margin. The middle seta is long and slender and the other two are subequal, and less than one-half as long as the middle seta.

Marginal setæ.—Under this heading are placed all the other

1.* An interesting experiment was conducted to determine the function of these so-called "digitules." An insect was placed on a cover-glass which was inverted and placed on the stage of a microscope with the insect in the hole usually occupied by the condenser. It was found that the insect held on to the glass by a sucker-like action of the "digitules"; it is evident from this that they are tenent hairs.

setæ found at the margin of the body. In *hesperidum* they are short, slender, and sharp-pointed, and occasionally bifurcated.

Spiracles.—There are two spiracles on each side of the body, one of them is located near the base of the first leg and one between the second and third legs. The external opening is beside a heavily chitinized crescent-shaped portion of cuticle from which extends an hour-glass-shaped portion of cuticle. (Plate II, Fig 8.)

Cuticle.—The cuticle does not present such striking characteristics as in some species described later, but on the dorsum there are occasional short setæ and small clear areas each of which contains a small dot.

SPECIFIC CHARACTERISTICS NOT PRESENT IN LECANIUM HESPERIDUM.

In addition to the setæ found in the anal region of *hesperidum*, there is present on the dorsum of the free portion of each anal plate of certain species, such as *oleæ*, *hemisphaericum*, *longulum*, and *filicum*, a single large seta, termed *the discal seta*. In *cornuparvum*, there are a number of small setæ on the ventral portion of the body-wall in front of the place where it invaginates to form the anal tube, and such are termed *the setæ of the hypopigium*. This species also has antennæ that are short with indistinct segments, and which have been termed "rudimentary," but we will call them *vestigial*.

In *nigrofasciatum* there are about twenty-nine low, conical appendages extending in an irregular row along the middle of the dorsum in front of the anal plates. In *corrugatum* there are a number of these appendages on the posterior portion of the dorsum (Plate II, Fig. 6).

In *hemisphaericum*, *longulum*, *oleæ* and *filicum* there are several blunt appendages at the margin of the body (Plate II, Fig. 7).

Cuticular markings.—In the dorsal cuticle of specimens rendered transparent by treatment with caustic potash, there are clear spots caused by what are considered to be cuticular glands that extend up from the hypoderm. It has been decided to apply the term *alveolate* to species that have the dorsum marked in this manner (Plate II, Fig. 11).

In other species, for example *perforatum*, the dorsum is divided into polygonal areas which give the cuticle a tessellated appearance; these areas are sometimes called *tesseræ*.

On the ventral surface, especially near the region beneath the anal plates, there are small rings surrounding stellate openings, which look like spinnerets, and that are the openings of glands (Plate II, Fig. 12). In *hemisphaericum* there are a number of unicellular glands that open on to the ventral surface and that secrete a whitish substance in which the eggs are laid (Plate II, Fig. 10). In *cornuparvum* there are many multicellular glands, especially abundant in the anal region, that open on the ventral surface (Plate II, Fig. 9).

EXAMPLES OF SPECIFIC DESCRIPTIONS.

Lecanium nocturnium (Ckll. and Parrott.)

(Plate III, Figs. 1, 2 and 3; Plate V, Fig. 1.)

The shape is broad, oval, and moderately convex. The dorsal cuticle is black, irregularly mottled in the sub-dorsal region with brown, or is all black. The margin of the dorsal cuticle is intersected by occasional clear streaks and is full of large, clear spaces and occasional fine punctuations, with many fine punctuations on the disc. Length, 4 mm.; width, 3.5 mm. The antenna has seven segments with the fourth the longest. The anal plate * is about two-thirds as broad as long with the cephalo-lateral margin longer than the caudo-lateral; the apex and lateral extremity are rounded; a round scar surrounds a small elliptical scar on the dorsum near the lateral extremity. There are three subapical and three apical setæ on each plate. There are four fringe setæ in groups of two, with the inner one of each group not one-half as long as the outer. The middle spiracular seta of each group is slightly tapering and is almost three times as long as the first; the other two of each group are blunt and conical. The marginal setæ are short and blunt, or acuminate. On the under surface of the body in front of the plates there are several spinneret-like organs which are also present on the dorsum in a similar region. Described from specimens donated the department of Entomology of Cornell University by Prof. T. D. A. Cockerell.

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* The dorsal portion of the anal plate is the part to which this description always refers.

Lecanium nigrofasciatum Pergande.

(Plate III, Figs. 7, 8 and 9; Plate V, Fig. 3.)

The shape is oval, broader posteriorly, and hemispherical. The cuticle varies in color from light or dark red to black, with the median stripe lighter and with small clear areas each of which contains a very small dot. There are also a few small setæ scattered on the dorsal surface. Length, 3–4 mm.; width, 2.6 mm. The antenna has six segments, the third, which is the longest, having three setæ. The anal plate is nine-sixteenths as broad as long with the cephalo-lateral and caudo-lateral margins subequal, and with the lateral extremity and apex sharp, and a faint scar close to cephalo-lateral margin near the lateral extremity. There are two subapical and three apical setæ with two of the latter on the outer lateral margin and one a slight distance from the apex. There are four fringe setæ in groups of two with the inner two one-half as long as the outer. The middle spiracular seta is broader at the apex than at the base and the other two are slightly tapering. The marginal setæ are short, hair-like and acuminate. On the dorsum there is an irregular row of about thirty low, conical appendages extending along the meson in front of the plates. (Plate II, Fig. 6.)

Lecanium hesperidum Linn.

(Plate III, Figs. 4, 5 and 6; Plate V, Fig. 2.)

The shape is oval, broader posteriorly, and slightly convex. The dorsal cuticle is yellowish-brown, darker towards the center with occasional clear areas, each of which contains a very small dot, and there are a few small setæ on the dorsal surface. Length, 3–4 mm.; width, 2 mm. The antenna is long and slender and has seven segments, with the fourth the longest. The anal plate is slightly more than twice as long as broad, with its caudo-lateral margin one-fifth longer than its cephalo-lateral; both the lateral extremity and the apex are rounded. The cephalic end of the crease between the dorsal portions of the plates terminates in a

V-shaped mark. There are two subapical and four apical setæ on each plate. The apical setæ are situated as follows: two are adjacent and directly on the apex; one is on the outer lateral margin and projects at a right angle; and one is on the inner lateral margin near the apex. There are four fringe setæ arranged in groups of two, with the lateral seta of each group one-fourth longer than the mesal seta. The median spiracular seta is almost three times as long as the first, and the first and third are short and conical. The marginal setæ are short and hair-like and occasionally bifurcated at apex. It is viviparous, and only a small portion of the ventral body-wall becomes concave when the young are born. Found in greenhouses on ferns.

Lecanium obtusum new species.

(Plate III, Figs. 10, 11 and 12; Plate V, Fig. 4.)

The shape is elliptical and very convex, with two swellings on the posterior portion. The dorsal cuticle varies from light to dark brown with occasional clear spaces at the margin. Length, 6 mm.; width, 4 mm. The antenna has seven segments, with the third and fourth subequal. The anal plate is five-ninths as broad as long, with the caudo-lateral margin slightly longer than the cephalo-lateral, and the lateral extremity and the apex are rounded. There are two subapical and four apical setæ on each plate, with the cephalic apical seta one-fifth of the length of the plate from the apex. There are four fringe setæ in groups of two. There are transverse rows of groups of short striations on the hypopigium. All three in each group of spiracular setæ are long and conical and the first seta is about one-half as long as the middle one. The marginal setæ are tapering and blunt, and the longest are over one-half as long as the first spiracular seta. Found on blackberry (*Rubus villosus*). Described from specimens in the Entomological Collection of Cornell University.

Lecanium perforatum Newstead.

(Plate III, Figs. 13, 14 and 15; Plate V, Figs. 5 and 6.)

The shape is oval, broader posteriorly, and very flat. The dorsal cuticle is dark brown and tessellated, with small clear dots around margin of tesseræ; round clear spots occur in the marginal tesseræ and irregular clear spots in the other tesseræ; and there is one irregular clear space in each of the posterior submarginal tesseræ (Plate V, Fig. 6). Length, 3.5 mm. to 4 mm.; width, 2.5 mm. to 3 mm.

The antenna is long and slender and has eight segments; the suture between the fourth and fifth segments is indistinct, with the fourth the longest. The anal plate is over twice as long as broad, with the caudo-lateral margin slightly longer than the cephalo-lateral and the apex very sharp and the lateral extremity angulate. The anterior end of the crease between the plates terminates in a V-shaped mark. There are three subapical and three apical setæ. There are four very long fringe setæ with the inner one of each group shorter. The median spiracular seta is two and one-half times as long as the first and is slightly hooked at the apex. The marginal setæ are slender and either acuminate or bifurcated. Collected from *Caryota Cumingii*, Palm House, Kew. Described from specimens given the Entomological Department of Cornell University by R. Newstead. Mr. Newstead states that it is viviparous.

Lecanium quercifex Fitch.

(Plate III, Figs. 16, 17 and 18; Plate V, Fig. 7.)

The shape is elliptical, tapering slightly at both ends. The dorsal cuticle is dark brown, with small clear areas each of which contains a very small dot. Length, 4 mm.; width, 3 mm. The antenna has seven segments, with the third and fourth subequal. The anal plate is slightly more than one-half as broad as long, with the lateral margins subequal, and the lateral extremity and the apex are rounded. There are two subapical and four apical setæ on each plate, with the latter clustered at the apex and the anterior seta one-ninth of the length of the plate from the apex. There are four fringe setæ subequal in length in groups of two. On the hypopigium, there are short transverse rows of short striations. All of the spiracular setæ are long and conical with the first one of each group slightly over one-half as long as the middle one. Most of the marginal setæ are short and blunt, with the longest less than one-half as long as the first spiracular seta. It is oviparous. Found on oak.

Lecanium oleæ Bernard.

(Plate IV, Figs. 1, 2 and 3; Plate V, Fig. 8.)

The shape is elliptical, and the dorsum is very convex and has a median, longitudinal carina and two traverse carinæ. The dorsal cuticle is dark brown and compactly alveolate. Length, 4–5 mm; width, 2 mm. The antenna has eight segments, with the third the longest; there are no setæ on the third and fourth segments, and one long and two short setæ on the fifth segment. The anal plate is almost twice as long as broad, with the cephalo-lateral margin two-thirds as long as the caudo-lateral, and the lateral extremity rounded. There are four subapical, one discal, and three apical setæ on each plate, with the longest one of the latter on the inner lateral margin. There are eight fringe setæ, of various lengths, in groups of four, with the inner one of each group about one-fourth as long as the outer one. The median spiracular seta is nearly four times as long as the first, and the first and third are long and conical. Some of the marginal setæ are short and acuminate, others are serrated at the ends and others are bifurcated. On the margin there are several appendages, see Plate II, Fig. 7. Specimens described were from California.

Lecanium longulum Douglas.

(Plate IV, Figs. 4, 5 and 6; Plate V, Fig. 9.)

The shape is narrow and long with rounded ends, and the dorsum is slightly convex. The dorsal cuticle is pale yellow and sparsely alveolate. Length, 4–5 mm.; width, 2–2.5 mm. The antenna has seven or eight segments, with the third segment the longest and without setæ, and one long and two short setæ on the fifth segment. The anal plate is almost two-thirds as broad as long, with its cephalo-lateral margin six-sevenths as long as its caudo-lateral, and the apex sharp. There are four subapical, one discal and three apical setæ on each plate, one of the latter being on the inner, lateral margin. There are eight fringe setæ, in groups of four, with one in each group one-half as long as the longest. The median spiracular seta is slightly over three times as long as the first, and the first and third are long and conical.

Most of the marginal setæ are acuminate but an occasional one is serrated at the end but not so distinctly as in *hemisphæricum*. Specimens collected from *Acacia* in Conservatory of the Department of Agriculture Washington, D. C.

Lecanium hemisphæricum Targioni Tozzetti.

(Plate IV, Figs. 7, 8 and 9; Plate V, Fig. 10.)

The shape is elliptical and the dorsum is very convex. The dorsal cuticle is light or dark brown, and densely alveolate, although not to such an extent as *oleæ*. Length, 3–4 mm.; width, 3 mm. The antenna usually has seven segments, but it may have eight, with setæ on all; the first segment has one long and two short setæ, and the third segment is the longest. The anal plate is nearly twice as long as broad, with its cephalo-lateral margin four-fifths as long as its caudo-lateral, and the lateral extremity of the plate is angulate and the apex rounded. On each plate there are, a discal seta, four subapical setæ, and three apical setæ with the one on the inner, lateral margin longest. The discal seta is occasionally fringed at the apex. There are eight fringe setæ arranged in groups of four, with one in each group slightly over one-half as long as the others. The middle seta of the spiracular group is three times as long as the first, and the first and third are long and conical. The long marginal setæ are serrated at the ends and the shorter ones are acuminate. There are many unicellular glands opening onto the ventral surface. It is oviparous, and when the eggs are laid the entire ventral body-wall becomes concave. Found in greenhouses on ferns.

Lecanium filicum Boisduval.

(Plate IV, Figs. 10, 11 and 12.)

The shape is oval and very convex. The dorsal cuticle is reddish brown and sparsely alveolate.

The antenna has seven or eight segments; the fourth segment is subequal in length with the third, and bears one short and two long setæ. The anal plate is five-eighths as broad as long, with its cephalo-lateral margin nearly as long as its caudo-lateral, and the lateral extremity angulate and the apex rounded. The plate is about two-thirds as long as the plate of ***hemisphæricum***. There are two subapical, one discal and three apical setæ on each plate. There are four fringe setæ in groups of two and they are subequal. The middle spiracular seta is twice as long as the first, and the first and third are long and conical. The marginal setæ are fan-shaped at the apex with an occasional acuminate one. Found in greenhouses on ferns.

Lecanium corrugatum, new species.

(Plate IV, Figs. 13, 14 and 15; Plate V, Fig. 11.)

The shape is globular. The dorsal cuticle is light brown with small clear areas each of which contains a very small dot, and it is much wrinkled after it is dry. Length, 4–5 mm.; width, 3–5 mm. The antenna is of the vestigial type and has three indistinct segments. The anal plate is nearly twice as long as broad, with the caudo-lateral margin slightly longer than the cephalo-lateral and the lateral extremity angulate. There are four subapical and three apical setæ on each plate. There are two long fringe setæ, and at least ten hypopigial setæ. The thickened ventral edge of the plate extends a considerable distance forward. The middle spiracular seta of each group is tapering, curved at the apex, and slightly more than twice as long as the first, and the other two setæ are conical. The marginal setæ are hair-like and acuminate. Many of the low conical appendages found in ***nigrofasciatum*** are present on the dorsum of the anal region of the body. Described from specimens in the Entomological Collection of Cornell University. Found on pine (*Pinus sylvestris*).

Lecanium cornuparvum, new species.

(Plate IV, Figs. 16, 17 and 18; Plate V, Fig. 12.)

The shape is elliptical and quite convex. The dorsal cuticle is shiny brown with a tinge of grey, and it is densely alveolate, with large glands. Length, 8–10 mm.; width, 5–8 mm. The spiracular grooves leave white dust when the insect is removed from the bark. The antenna is short and stout with six indistinct segments, and is of the vestigial type. The anal plate is two hundred and forty-eight microns long (the anal plate of *hesperidum* is two hundred microns long) and is two-thirds as broad as long, with the cephalo-lateral margin longer than the caudo-lateral, and both the lateral extremity and the apex rounded. There are five subapical and four apical setæ. There are two large fringe setæ, one on each ventral thickening and at least sixteen hypopigial setæ. There are three short, stout spiracular setæ, subequal in length, and about one-half as broad as long, with the median seta notched at the apex. The marginal setæ are short and conical. The legs are short and stubby with a small claw. Found on Magnolia at Trumansburg, N. Y. It is viviparous, with the young scales, black. The dried young have a median carina and many transverse carinæ.

In *Lecanium magnoliarum* Ckll. the antennæ are long and slender with eight distinct segments.

KEY TO THE ABOVE SPECIES OF LECANIUM.

A. Discal seta present.
B. Eight fringe setæ.
C. Caudo-lateral margin of plate distinctly longer than cephalo-lateral; lateral extremity of plate rounded; cuticle compactly alveolate .... *oleæ.*
C.C. Lateral margins of plate nearly equal; lateral extremity of plate angulate.
D. Cuticle densely alveolate; apex of plate rounded *hemisphaericum.*
DD. Cuticle sparsely alveolate; apex of plate sharp.... *longulum.*
B.B. Four fringe setæ.. *filicum.*
A.A. Discal seta absent.
B. Hypopigial setæ and vestigial antennæ present.
C. Cephalo-lateral margin of plate distinctly longer than caudo-lateral; lateral extremity rounded........................ *cornuparvum.*
C.C. Lateral margins of plate about equal; lateral extremity angulate .... *corrugatum.*
B.B. Hypopigial setæ and vestigial antennæ not present.
C. Cuticle tessellated; apex of plate very sharp.......... *perforatum.*
C.C. Cuticle not tessellated.
D. Anal plate over twice as long as broad............. *hesperidum*
DD. Anal plate not twice as long as broad.
E. Fringe setæ nearly equal in length.
F. Cephalic apical seta one-fifth of length of plate from apex and longest marginal setæ over one-half as long as the first spiracular seta* .... *obtusum.*
F.F. Cephalic apical seta one-ninth of length of plate from apex and longest marginal setæ less than one-half as long as the first spiracular seta .... *quercifex.*
E.E. Inner fringe setæ considerably shorter than outer fringe setæ.
F. Low conical appendages on middle of dorsum........ .... *nigrofasciatum.*
F.F. No conical appendages on dorsum .... *nocturnium.*

EXPLANATION OF FIGURES.

(All the drawings were made with the camera lucida except when otherwise indicated.)

PLATE I.

Lecanium hesperidum Linn.

Fig. 1. Ventral view, 12 diameters.
2. Dorsal view of posterior portion, 12 diameters.
3. Cross-section through anterior portion of anal tube, 120 diameters.

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* The anterior seta of the anterior group.

4. Plan of anal region from ventral side 150 diameters.
5. Cross-section through anal region near middle of anal tube, 120 diameters.
6. Cross-section through anterior part of anal plates, 120 diameters.
7. Cross-section through anal plates near widest part, 120 diameters.
8. Cross-section through anal plates near apexes, 120 diameters.
9. Cross-section through body behind anal plates, 120 diameters.
10. Cross-section through body still farther caudad, 120 diameters.

PLATE II.

Fig. 1. Sagittal section through anal region of *hesperidum*, 200 diameters.
2. Posterior end of a *hesperidum* before birth, 200 diameters.
3. Dorsal view of posterior end of a *hesperidum* just after birth, 150 diameters.
4. Diagram of anal plates to illustrate terms used in text, 150 diameters.
5. Cross-section of anal plate of *hemisphæricum* through discal seta, 120 diameters.
6. Conical appendage of *nigrofasciatum*, 287 diameters.
7. Appendage found on margin of *oleæ*, *hemisphæricum*, *filicum*, *longulum*, 287 diameters.
8. Spiracle of *filicum*, 150 diameters.
9. Multicellular gland in *cornuparvum*, 150 diameters.
10. Unicellular gland in *hemisphæricum*, 150 diameters.
11. Glands in dorsal body-wall of *hemisphæricum*, 150 diameters.
12. Spinneret (Free-hand).
13. Pro-thoracic leg of *hemisphæricum*, 150 diameters.

PLATE III.

(All figures on this plate magnified 150 diameters.)

Fig. 1. Anal plates of *nocturnium*.
2. Spiracular and marginal setæ of *nocturnium*.
3. Antenna of *nocturnium*.
4. Anal plates of *hesperidum*.
5. Spiracular and marginal setæ of *hesperidum*.
6. Antenna of *hesperidum*.
7. Anal plates of *nigrofasciatum*.
8. Spiracular and marginal setæ of *nigrofasciatum*.
9. Antenna of *nigrofasciatum*.
10. Anal plates of *obtusum*.
11. Spiracular and marginal setæ of *obtusum*.
12. Antenna of *obtusum*.
13. Anal plates of *perforatum*.
14. Spiracular and marginal setæ of *perforatum*.
15. Antenna of *perforatum*.

16. Anal plates of *quercifex*.
17. Spiracular and marginal setæ of *quercifex*.
18. Antenna of *quercifex*.

PLATE IV.

(All figures on this plate magnified 150 diameters.)

Fig. 1. Anal plates of *oleæ*.
2. Spiracular and marginal setæ of *oleæ*.
3. Antenna of *oleæ*.
4. Anal plates of *longulum*.
5. Spiracular and marginal setæ of *longulum*.
6. Antenna of *longulum*.
7. Anal plates of *hemisphæricum*.
8. Spiracular and marginal setæ of *hemisphæricum*.
9. Antenna of *hemisphæricum*.
10. Anal plates of *filicum*.
11. Spiracular and marginal setæ of *filicum*.
12. Antenna of *filicum*.
13. Anal plates of *corrugatum*.
14. Spiracular and marginal setæ of *corrugatum*.
15. Antenna of *corrugatum*.
16. Spiracular and marginal setæ of *cornuparvum*.
17. Anal plates of *cornuparvum*.
18. Antenna of *cornuparvum*.

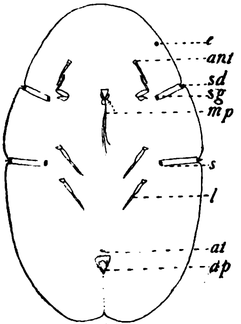
PLATE V.

(All figures on this plate magnified 150 diameters.)

Fig. 1. Dorsal cuticle of *nocturnium*. Posterior portion near margin.
2. Dorsal cuticle of *hesperidum*. Portion in front of plates.
3. Dorsal cuticle of *nigrofasciatum*. Near margin.
4. Dorsal cuticle of *obtusum*. Posterior portion near margin.
5. Dorsal cuticle of *perforatum*. Posterior portion at the margin.
6. Irregular clear space in each of eight posterior submarginal tesseræ of *perforatum*.
7. Dorsal cuticle of *quercifex*. Discal portion.
8. Dorsal cuticle of *oleæ*. Anterior portion near margin.
9. Dorsal cuticle of *longulum*. Posterior portion near margin.
10. Dorsal cuticle of *hemisphæricum*. Discal portion.
11. Dorsal cuticle of *corrugatum*. Near margin.
12. Dorsal cuticle of *cornuparvum*. Near margin.

EXPLANATION OF ABBREVIATIONS.

a.	Anus
ant.	Antenna.
ap.	Anal plates.
as.	Apical setæ.
at.	Anal tube.
ax.	Apex.
c.	Crease.
cdm.	Caudo-lateral margin.
cm.	Cephalo-lateral margin.
ct.	Cuticle.
db.	Dorsal body-wall.
ds.	Discal seta.
e.	Eye.
fs.	Fringe setæ.
h.	Hypodermis.
hs.	Hypopigial setæ.
l.	Legs.
le.	Lateral extremity.
m.	Muscle.
mp.	Mouth-parts.
ms.	Marginal setæ.
n.	Nuclei.
r.	Rectum.
s.	Spiracle.
sar.	Setæ of anal ring.
sc.	Scar.
sd.	Spiracular depressions.
ser. s.	Serrated setæ.
sg.	Spiracular groove.
si.	Second invagination.
so.	Sense organ.
sp. s.	Spiracular setæ.
ss.	Subapical setæ.
th.	Tenent hairs.
v.	Vagina.
vb.	Ventral body-wall.
vt.	Ventral thickening.



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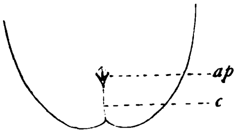

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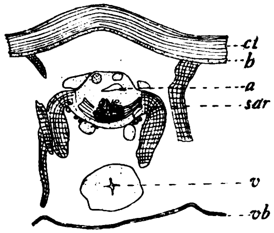

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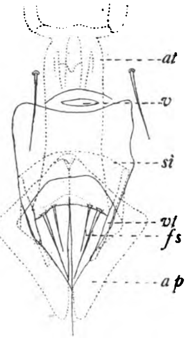

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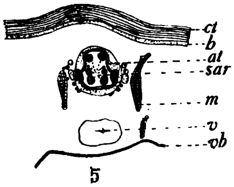

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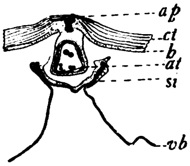

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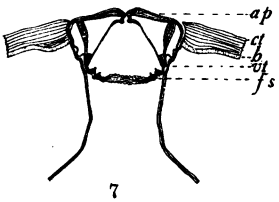

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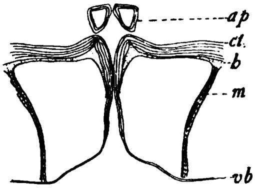

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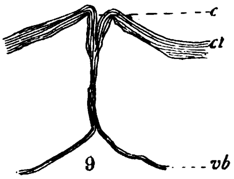

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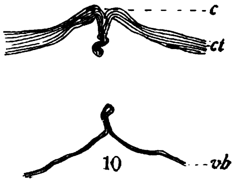

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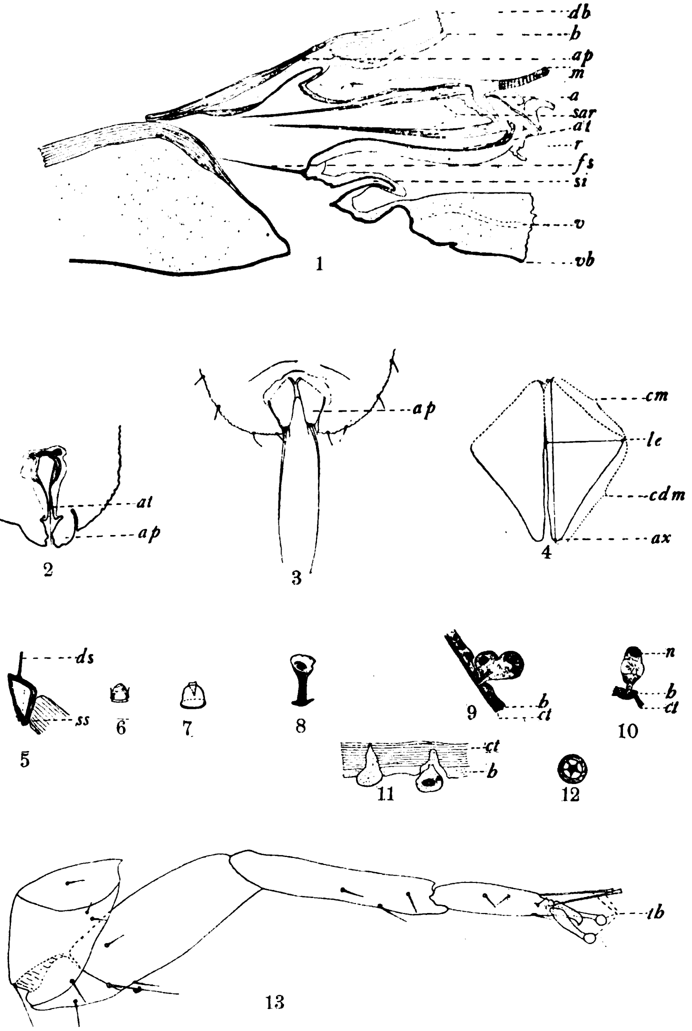
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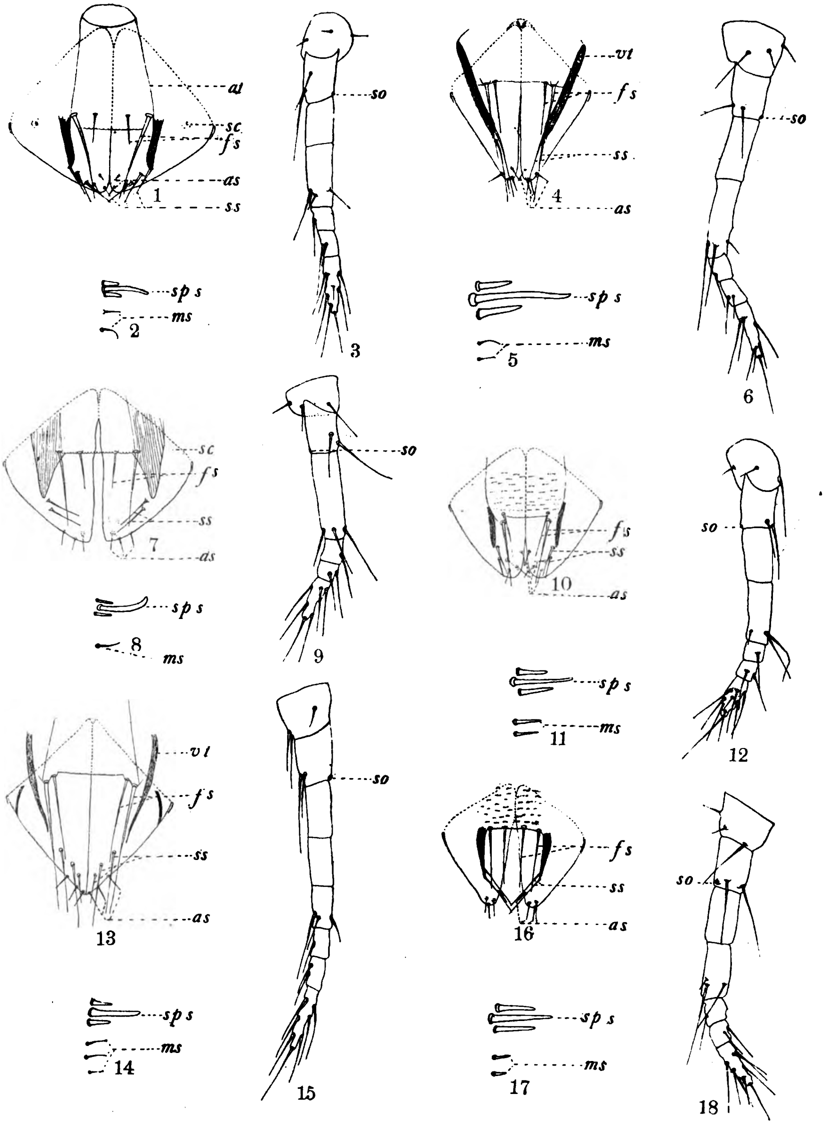
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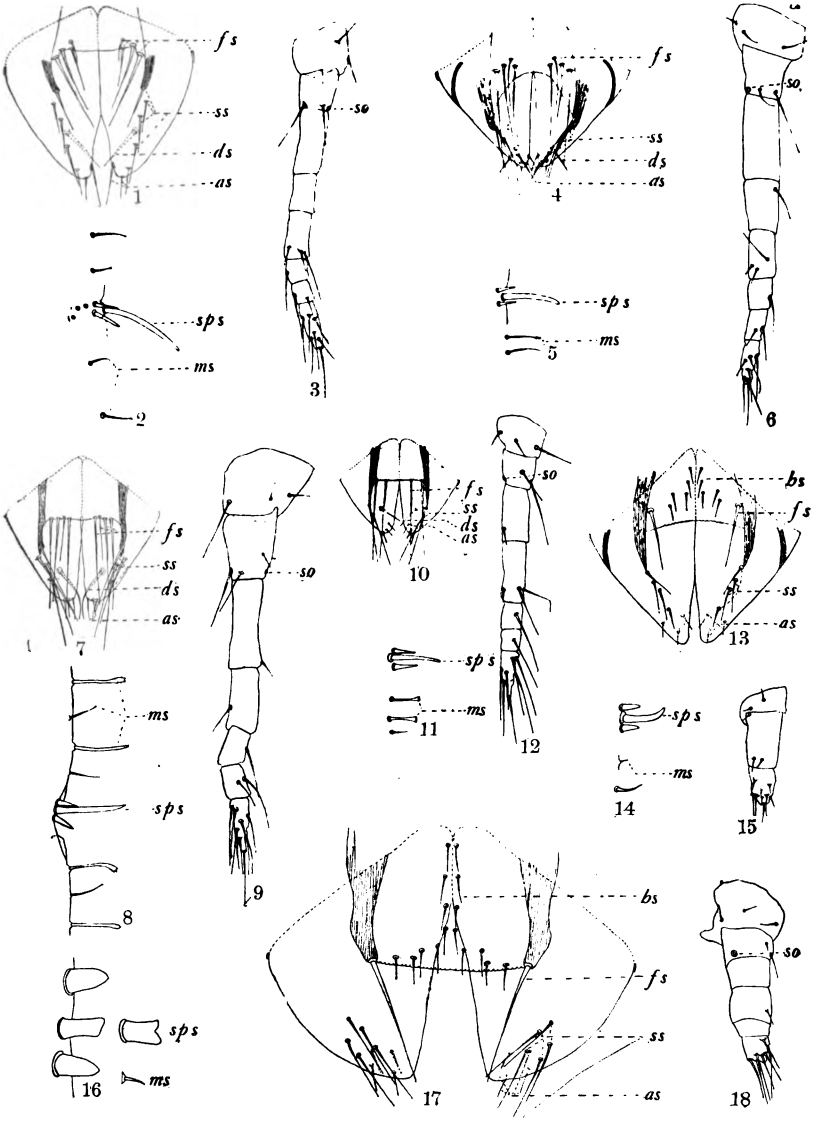
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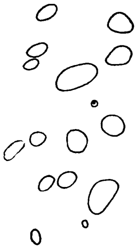

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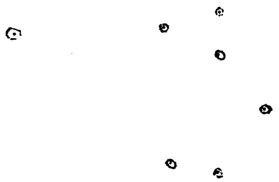

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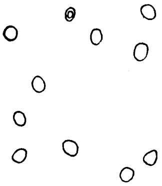

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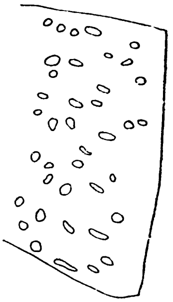

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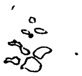

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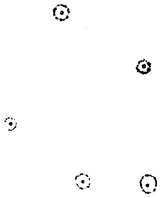

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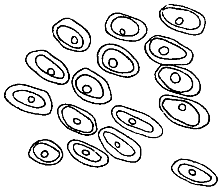

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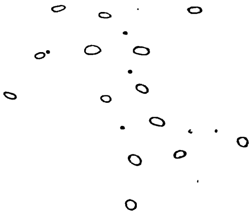

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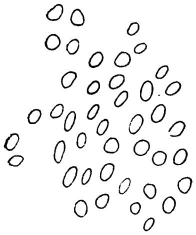

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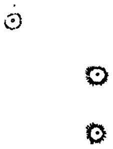

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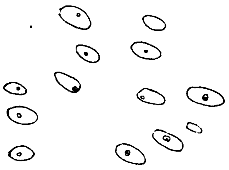

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PLATE V.

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